The ASV-MK19B Airborne Radar – ARI 5838

System:

Type:	Airborne search radar, antisubmarine, ship detection & navigational aid.
Tx/Rx:	Centimetric, with common Tx/Rx waveguide.
Frequency:	9240 ± 30 MHz.
Power Output:	7 to 10 KW.
Pulse Width:	1 µsecond.
Pulse Repetition Frequency:	700.
Rx:	Superheterodyne with Crystal Mixer.
Local Oscillator:	Reflex Klystron with manual or automatic frequency control.
Intermediate Frequency (IF):	45 MHz.
IF Bandwidth:	2 MHz.

Antenna System:

Scanner:	Cut parabolic dish, gyro stabilized in pitch and roll axis.
Azimuth Sweep:	360º
Beam Shape:	Pencil.
Beam Width:	Azimuth 4º and Elevation 6º.
Tilt:	+ 5º to - 10º.

Display:

Type:	PPI, using 5” dia. electromagnetic deflection CRT.
Time Base:	Radial, synchronized to scanner rotation.
Signal Presentation:	Intensity modulation.
Range:	10 & 40 nautical miles (2 ranges). Range markers at 2 mile intervals on 10 nm range and 5 mile intervals on 40 nm range.
	Open centre facility on the 10 nm range to improve bearing discrimination of short range targets.

Power Supplies:

(1)	115V	1600 Hertz	Single Phase.
(2)	115V	400 Hertz	3 Phase.
(3)	28V	DC.	

Sub Assembly:

1. Scanner Unit Type 123
2. TR Unit Type 3009
3. Synchroniser Unit Type 30
4. Indicator Units (2) Type 101
5. Control Units Type 625 & 928
6. Amplifier Unit Type 3700
7. Gyro Unit Mk 5
8. Junction Box Type 388 & 390
9. Switch Unit Type 515.

Operation:

A master timing circuit (pre pulse generator) produces a 50 µsecond pulse at a PRF of 700.
The 'back' edge of this pulse is used to trigger a 1 µsecond wide voltage pulse which modulates the magnetron. The magnetron produces a pulse of X Band RF oscillation which is radiated in the form of a pencil beam by a rotating scanner.

The scanner continually rotates through 360º, and is gyro stabilised in the pitch and roll axis to prevent changes in aircraft attitude affecting the radiated beam.

Stabilisation is effective for angles of roll not exceeding 30º port or starboard, and for angles of pitch not exceeding 11º. This ensures that the scanner position remains virtually unaffected by normal aircraft manouvres of banking, climbing or diving.

The scanner dish may also be tilted 5º up or 10º down, this function being controlled by the operator.

A common Tx/Rx waveguide system is used, and received signals are fed to a Crystal Mixer where they are 'mixed' with the output of the Local Oscillator, the frequency of which is controlled by the AFC system (Automatic Frequency Controller). The Mixer output is fed to the IF amplifier which is tuned to 45 Mhz. This amplified signal contains the detected target signals.

Resultant video signals are fed to the Display where they are used to Intensity Modulate the Cathode Ray Tube (CRT)

The 50 µsecond 'pre pulse' is also used to trigger a time base circuit which produce a sawtooth shaped current waveform.

The display uses electromagnetic deflection and the time base waveform is fed to the deflection coils through a Resolver Magslip geared to the scanner dish. This ensures that the position of the time base on the display is accurately synchronized to the direction in which the scanner is pointing.

On the 40 nm range, the start of the time base coincides with the start of the transmitted pulse. The PPI display (Plan Position Indicator) shows zero range at the centre of the tube, the time base rotating 360º about this point.

On the 10 nm range, the 'start' of the timebase is advanced with respect to the transmitted pulse, and zero range is represented by a circle, the radius of which is proportional to the time between the start of the timebase and the transmitted pulse. This display is called an open centre PPI.

Operational Controls:

Operational controls for this radar are on the Control Unit Type 625 and Indicating Unit Type 101.

Range Switch:
A 2 position switch mounted on the Control Unit enables the operator to select either the 10 or 40 nautical mile range.

Power Switch:
The power ON/OFF switch is on the Control Unit. When switched ON, a 3 minute delay must elapse before the display appears. This delay protects the transmitter (*magnetron really*) and occurs even if the equipment has been operating continuously and is momentarily switched off.

Stabilization Switch:
The Stabilization switch is also on the Control Unit, and when OFF, holds the scanner to the aircraft's axis. In the ON position, the scanner is stabilized against pitch and roll.

Gyro Erect Button:
When this button is pressed, the gyro is quickly erected by the application of an AC supply direct to the torque motors. The following precaution must be taken using this control:

1. the button must only be pressed when the aircraft is flying straight and level or the gyro will not erect to the correct position,
2. the button must not be pressed within 1 minute of setting the Stabilization Switch ON,
3. the button must not be pressed for more than 1 minute.
   Failure to observe these precautions may cause severe damage to the gyro unit.

The Tx Switch:
The Tx ON/OFF/RESET switch is mounted on the Control Unit and normally

kept in the ON position. When switched OFF, the Tx is shut down, and the display goes blank.

Tuning Controls:
There are 2 tuning controls, both mounted on the Control Unit. The AFC/Manual Tune switch enables automatic or manual tuning.

Tilt Control:
This knob allows the scanner to be tilted within the range of + 5º or - 10º in elevation.

Gain Control:
The calibrated gain control on the Control Unit determines the gain of the 3rd and 4th stages of the IF amplifier. It is normally set so that position 8 of the control gives maximum gain without limiting strong signals.

Azimuth Switch:
This is mounted on the Indicator Unit and is normally left ON. It controls the rotation of the scanner dish. If 2 indicators are fitted to the aircraft, both switches must be ON, or the scanner will not rotate.

Display Controls:
These are 3 being: (a) Brilliance, (b) Focus and (c) Range Marker amplitude.

Video Filter Switch:
This is also fitted on the Indicator Unit. The IN position should be selected when strong sea returns makes the detection of short range targets difficult.

Operating Instructions:

1. Switch the MK19B power supplies ON
2. Select TX switch to ON
3. Select AZIMUTH switch to ON
4. Select STABILIZATION switch to ON
5. Select AFC/MAN TUNE switch to AFC
6. Select VIDEO FILTER switch to OUT
7. Select RANGE as required.
8. Select power switch on the Control Unit to ON.

Performance Testing the ASV-MK19B:

Test equipment used:

(a) Performance Tester Type 103.
This is a monitoring set for the Synchronizer Unit, the output of which can be displayed on an oscilloscope. The waveforms available for display are:

- Trigger pulse
- Generated timebase waveform
- Bright-up waveform
- +250VDC with or without ripple
- 3 phase supply to the scanning unit and the pitch and roll motors can also be checked.

(b) Meter Unit (monitoring) 10AF/534:
This item is used for checking the following points on the TR3699.

- Circuit voltages
- Crystal currents
- Crystal ratios
- Klystron reflector voltage.

(c) Test Set (Gyro Output) Type 4037:

- This test set is used to test the MK19B stabilization system. The variable controls on it can be used to manually control the scanner in pitch and roll or it can be used to test the output of the gyro unit.

(d) Output Tester Type 4036:

- This consists of a small neon tube which can be screwed into the waveguide for standing wave ratio checks, ie VSWR.

(e) X-Band Noise Tester:

- This consists of a Power Unit Type 908 which provides a voltage to strike the output noise source. (??) This is a discharge tube filled with Argon gas.

(f) Detector Unit (Measuring) Type 79:

- This is a meter used in conjunction with the above item to indicate noise outputs of a receiver.

Tests Carried Out:

a. Power output check,

b. Roll and Pitch electrical adjustments,

c. Amplifier Voltage adjustment and Servo Motor Current checks,

d. TR unit PRF, Crystal, Voltage, Peak Power, RF Alignment, AFC Locking, TR Cell Tuning, Receiver Overall Noise Factor and VSWR checks,

e. Synchronizer Unit Voltage, Time Base duration, Time Base amplitude and Balance checks,

f. Indicator alignment,

g. Gyro alignment.

Performance of Tests:

Performance of the above tests (a to g) are detailed as follows:

a. The Power Output check is performed using the Wattmeter Absorption Type 2 and feeding the output of the TR3699 into it. The height of the glow of the neon tube indicates the power output, and should be greater than 4.

b. Roll and Pitch adjustments are performed using Test Set 4037 and Performance Tester Type 103. Roll and pitch variations imposed on the test set should send the scanner to the same positions in roll and pitch. If not, RV3 and RV4 are adjusted to correct the difference.

c. Amplifier Voltage and Servo Motor Currents are checked using the Meter Unit (Monitoring) 10AF/534 and Performance Tester Type 103. The voltages are checked on the meter unit and the servo motor currents are checked on the scanner stabilized position and with the roll and pitch dials varied accordingly.

d. These tests are performed as as follows:

The PRF is checked against a calibrated frequency meter for 700 pulses per second.

Crystal checks are carried out for back to front ratios (>10 to 1) using the Crystal Ratio
positions on the Meter Unit (Monitoring)

RF alignment check is done using an oscilloscope and observing that the waveform changes from positive to negative as the Manual Tuning Control is varied about its centre point. The AFC and Crystal Signal currents are also adjusted to 0.3 mA using the Meter Unit (Monitoring)

The AFC locking check is carried out using position 5 of the Meter Unit Monitoring) and with the cross-over waveform indicated on the oscilloscope, the AFC crystal current should not change when the AFC/Manual Tune switch is selected to either position.

TR cell tuning is carried out by adjusting the TR cell locking device for maximum trace length on the oscilloscope.

The Receiver Overall Noise Factor is checked using the X-Band Noise Tester and Detector Unit Type 79. The output on the Detector Unit is checked with the noise ON and OFF. The difference between the 2 output readings is the overall noise factor.

The Voltage Standing Wave Ratio is checked using the Output Tester (NSN) Type 4036. With the maximum neon indication adjusted to 6.5, the sliding assembly is then adjusted for maximum height indication of the neon. This must be greater than 5. (ie. A VSWR of 0.77)

e. Synchronizer Voltage, Time Base duration and amplitude, and Balance checks are carried out using the Meter Unit (Monitoring). The time base duration, amplitude and balance checks are carried out using the 2 PPI's and aligning them if they are not presenting the correct displays.

f. Indicator alignment is checked by noting the controls on both indicators and the control unit perform the correct functions on the indicators.

g. Gyro alignment is checked using the Test Set (Gyro Output) Type 4039 and an oscilloscope. The gyro must be able to erect itself within 1 minute in both pitch and roll, and the run down time of the gyro must exceed 7 minutes.